Sirius
A Triple Star System

How true is it in terms of astronomy?

from The DogonAndSirius Website

Sirius C exists

From 'Un Systeme Soudanais de Sirius'

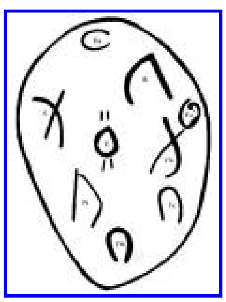
The paper enumerates a number of astronomical statements as follows (links to Astronomical Tests):

- "The orbit describing Digitaria around Sirius is perpendicular to the horizon" -- p280
- "When Digitaria is close to Sirius, it becomes most brilliant; when it is furthest away, Digitaria gives a scintillation which the observer believes as many stars." -- p281
- "The period of the orbit is counted double, that is 100 years." -- p282
- "Besides its movement of translation, Digitaria turns on itself in a year." -- p283
- "The Star [Digitaria], which is white, where Sirius is seen as red, is the origin of all things." -- p284
- "The contents of the recipient star are ejected by centrifugal force, in the form of infinitely small parts comparable to grains of Digitaria developing quickly: 'The things exiting to outside the star become as big as it every day.'" -- p286-7
- "Digitaria is the smallest of all things, and the heaviest star" -- p287
- "It [Digitaria] is composed of a metal named sagala, a little brighter than iron, and of a weight that everyone on earth cannot lift it. The star weighs 480 mule loads (about 35,000 kg), or all grains, or all the iron on earth, if they were theoretically the size of a stretched cow hide or a mortar board." -- p287
- "But Digitaria is not the sole companion of Sirius: the star emme ya, 'Sorghum Female,' more voluminous than it, but four times lighter than it, follows a vaster trajectory in the same direction and the same time as it (50 years). Their respective positions are where their rays make right angles." -- p287
- "It [emme ya] also emits rays which have the quality of solar rays." -- p288
- "it [emme ya] is accompanied by a satellite which is named "star of Women," nyan tolo" -- p288

These statements are supported by the following diagram, among others:

Nyan aduno tonu (Drawing of the World of Women) or
Anduno dale donule tolo (Drawing of the Heights and Depths of the World) -- p290

This is the drawing that kicked off 50 years of controversy. This most compelling feature of Un Systeme Soudanais de Sirius claims to give a overview of the whole Sirius system, an executive summary of the foregoing statements. True size is about twice this.



- **S**: Sirius A (sigi tolo -- "Star of Yasigi")
- **Da-b**: Sirius B, the "egg of the world," at extreme orbital positions (po tolo -- "Star of Fonio")
- **E**: Sirius C (emme ya tolo -- "Star of Sorghum Female") showing "rays" surrounding it. "Put at the centre of the egg as the Sun at the centre of the solar system."
- **Fa**: Sirius C's planet (nyan tolo -- "Star of Women"). The small spiral shows it is a satellite of "Sorghum Female."
- **Fb**: "Sign of women"
- **Fc**: "Sex of women"
- **R**, **N**: Mythical personages:
- **R**: Yurugu, the Fox
- **N**: Nommo, the Fish

This is one of the "raw documents" which Griaule and Dieterlen were so eager to share. The style of presentation of Un Systeme Soudanais de Sirius is in fact better described by Claude Meillassoux.

"Far from taking the form of verbatim transcriptions in the native language, they combine translations of brief quotations with paraphrases, interpretations and commentaries... it is practically impossible to distinguish between what originates from the informants and what comes from the anthropologist."

We should not be surprised. To quote a conservative source, the *Harvard Bright Star Catalog:*

> "**C**, companion to **B** at 1.4" suspected but not confirmed"

It says this sort of thing for a thousand stars where the suspicion is probably correct. One support for the existence of Sirius C is as an explanation for the historical "Red Sirius."

Bonnet Bidaud and **Gry** say:

If Sirius is a typical hierachical system in which a low-mass star is in a wide eccentric orbit around the inner A–B binary, the periodical irruption of this low mass (and therefore yet undetected) companion inside the inner binary could cause enough matter to be expelled to produce the observed reddening. To test this hypothesis, we undertook optical observations to search for this companion.

The effect of the third companion passage inside the inner binary will likely be the stripping of matter from the larger cross-section star, Sirius A.

A hierachical triple Sirius may therefore reproduce the temporary reddening reported by some historical sources.

After Sirius B was discovered in 1867, the following statement is relevant.

As soon as 1894, irregularities were found in the motion of Sirius B, and lead to suspect the existence of a third body in the system. Moreover, observations, mainly in the 1920's, and reflexions on physics of Sirius A, came and supported this hypothesis. But this is still controversial, as we will see below (for more historical details about this section, see e.g. Allen 1963; Baize 1931, 1987; Benest 1987).

Benest and Duvent

Observations of Sirius C in the 1920s:

A tiny star ($m_v \approx 12$) has been observed about twenty times between 1920 and 1930. If there was a real object and not a "phantom" – the observers themselves were sometimes in doubt –, an orbit of around 2 years could roughly agree. However, we will see that this period does not fit with the results of the orbital analysis.

Benest and Duvent

Details of the 1920s Observations:

> "As for a third star, Phillip Fox reported in 1920 that the image of Sirius B had appeared to be double, using the same 18 1/2 inch refractor with which Clark discovered **B**. R.T.Innes in S. Africa and van den Bos, a renowned double-star observer, also reported the 3rd star. I should note here that these were visual studies, and the object in question is at the very limit of what can be observed with a telescope. "
> **-- Tom Randolph**

This was the knowledge available in 1950.

In 1973 **I.W.Lindenblad** (author of the first photographs of Sirius B) of the U.S. Naval Observatory concluded that there was no astrometric evidence for a 3rd star, and this seemed to shut the case for a while, along with the authoritative statements of Sirius **C** skeptics Gatewood and Gatewood, who took detailed measurements of **B**.

However, the question is still taken seriously by professional astronomers, for other reasons, and in 1995 was published Is Sirius a Triple Star?, by **D. Benest** and **J.L. Duvent**. Astronomy and Astrophysics 299, 621-628 (1995) Their case is based on orbital analysis of A and B.

Despite Lindenblad's observational failure, three independent mathematical methods with updated and more accurate orbital data show a perturbation of 6.3 years, which B&D hypothesize to be the orbital period of the third body, Sirius C.

This period may be searched through a study of variations of the areal velocity; Zagar in 1932 used this method and found a period of 6.3 years, for a perturbing body around Sirius B; but we must note that this method requires several hypotheses so that the result depends on the chosen procedure (see Volet 1932). More simply, and more rigorously, the period of the perturbation can be obtained by a least square algorithm, which Volet (1932) solved analytically. He proposed then the value of 6.4 years around Sirius B, but possibly also around Sirius A; more recently, one of us used an analogous algorithm for numerical computation and obtained a value around 6 years (this will be developed in Sect. 2). Finally, another possibility is simply to apply a Fourier analysis to detect the period of perturbation.

We have therefore three independent methods giving rather close values; we think then that this is a rather strong indication in favour of the reality of the perturbation.

2.4. Concluding the orbital analysis

Process enhancements, more data used and two new methods confirm the previous studies, that a 6.3 years period perturbation probably exists in Sirius A–B orbit. More accuracy shows that the perturbation amplitude is 0.055″; as we know Sirius' parallax, A mass and B mass, we can estimate C mass and distance from its primary, which, as shown in the next section, is very likely Sirius A.

They say it must be a red/brown dwarf of 0.05 Mo, and offer suggestions to observe it in the infra-red spectrum "within 3" of Sirius A." In the paper about Red Sirius, Bonnet-Bidaud & Gry make an observation of Sirius' stellar field by masking the great brightness of Sirius A.

They come up with several candidate objects for Sirius C.

We note that no star brighter than an apparent magnitude of $m_v > 14$ (absolute magnitude $M_v > 17$ if at Sirius distance) is seen.

This excludes the possibility of a companion more massive than 0.1 $M_\odot$ and indicates that a Sirius companion, if any, would have to be close to the lower mass limit ($\approx 0.08\,M_\odot$) at which stellar configurations are able to sustain thermonuclear reactions.

Unfortunately, these objects on either sides of the mass limit are not well known and their identification is therefore uncertain (see Kafatos et al. 1986). They are however very red, thus among the nine brightest objects in our sample the best candidates to belong to the Sirius system are the 2 stars which appear to be redder than M8 type stars, namely star 4, with M_v around 20, $B-V=3.0$ and $V-I=2.8$, and marginally star 3, with $M_v=19.2$, $B-V=2.0$ and $V-I=2.5$. Their distances from Sirius are 76″ for star 4 and 60″ for star 3, which implies, since the system is 2.7 pc away, projected distances of respectively 205 and 165 AU.

Benest and **Duvent** say,

Bonnet-Bidaud & Gry (1991) have observed the vicinity of Sirius and proposed several faint stars ($m_v \geq 17$) as candidates, but they are all so far from Sirius B that they could actually be only remote companions of the system (see also Bonnet-Bidaud & Gry 1992).

There is also an amount of indirect collateral evidence for Sirius **C**. Red dwarfs are a common class of star but generally small and faint, and hard to observe.

Hence the surprise at the 1997 discovery that one was rather close by:

Follows the NASA ADS abstract from
The Solar Neighborhood
IV. Discovery of the Twentieth Nearest Star System
HENRY, TODD J.; IANNA, PHILIP A.; KIRKPATRICK, J. DAVY; JAHREISS, HARTMUT
Astronomical Journal v.114, p. 388-395 (07/1997)

"As part of a RECONS (Research Consortium on Nearby Stars) effort to discover stars nearer than 10 parsecs, LHS 1565 (GJ 1061; V = 13.03; M5.5 V) has been found to be only 3.7 parsecs from the Sun using a combination of photometric, spectroscopic and trigonometric parallax work. It ranks as the twentieth closest stellar system and underscores the incompleteness of the nearby star sample, particularly for objects near the end of the main sequence.

Ironically, this unassuming red dwarf provides a shocking reminder of how much we have yet to learn about even our nearest stellar neighbors."

For instance, another pioneering result of "seeing the faint" occurred in 1994 with discovery of Gliese 623b.

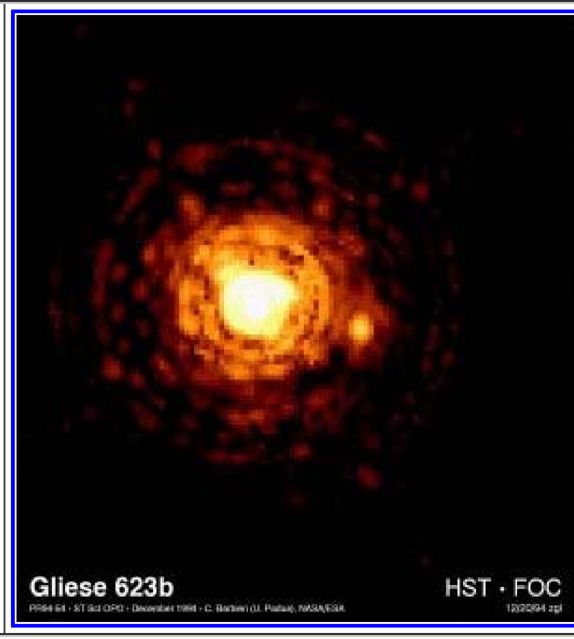
PHOTO RELEASE NO.: STScI-PRC94-54
RELEASE DATE: DECEMBER 21, 1994

HUBBLE FINDS ONE OF THE SMALLEST STARS IN THE UNIVERSE

This NASA Hubble Space Telescope picture resolves, for the first time, one of the smallest stars in our Milky Way Galaxy. Called Gliese 623b or Gl623b, the diminutive star (right of center) is ten times less massive than the Sun and 60,000 times fainter.
.
(If it were as far away as the Sun, it would be only eight times brighter than the full Moon).

Located 25 light-years away in the constellation Hercules, Gl623b is the smaller component of a double star system, where the separation between the two members is only twice the distance between Earth and the Sun (approximately 200 million miles).

The small star completes one orbit about its larger companion every four years.



Test 11
Sirius C has "rays" (flares?)

From 'Un Systeme Soudanais de Sirius'

- "It [emme ya] also emits rays which have the quality of solar rays." -- p288

It has been hypothesized that Sirius **C** became visible in the 1920s because of flaring (the observations do not match Benest and Duvent's orbital data, see above). Red dwarf flaring was discovered on October 12, 1994 by a team led by Dr. **Jeffrey Linsky** at the *Joint Institute for Laboratory Astrophysics* (**JILA**) in Boulder, Colorado, in another observation of faint objects with the Hubble Space Telescope.

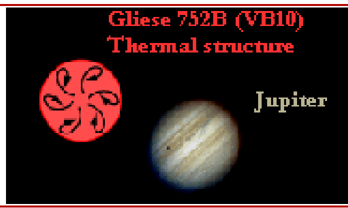
The star Gliese 752b (VB10) and its companion star Gliese 752a make up a binary system located 19 light-years away in the constellation Aquila. Gliese 752a is a red dwarf that is one-third the mass of the Sun and slightly more than half its diameter. By contrast, Gliese 752b is physically smaller than the planet Jupiter and only about nine percent the mass of our Sun.

This very faint star is near the threshold of the lowest possible mass for a true star (0.08 Mo), below which nuclear fusion processes cannot take place according to current models, and "brown dwarf" stars result.

Using Hubble's *Goddard High Resolution Spectrograph* (**GHRS**) to look for solar flares as occur on our own sun, there was surprise that while the larger red dwarf was flaring as predicted, tiny Gliese 752b, 0.08Mo, normal temperature 4,500 degsF,

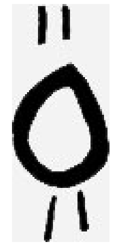
also produced a flare of 270,000degsF, despite not having a radiative core, meaning that it must have a strong magnetic field or "dynamo."

Hence Sirius **C**, a star said to be of similar size, could also flare.



The Dogon say that emme ya "*also emits rays which have the quality of solar rays*" and give these rays the symbol which must be considered another triumph of imaginative thinking.

For a star that "might not exist" we have hard numbers for mass, size, orbit and even an idea of its internal structure.



Test 12
Sirius C is bigger but four times lighter than Sirius B

From 'Un Systeme Soudanais de Sirius'

- "But Digitaria is not the sole companion of Sirius: the star emme ya, 'Sorghum Female,' more voluminous than it, but four times lighter than it, follows a vaster trajectory in the same direction and the same time as it (50 years). Their respective positions are where their rays make right angles." -- p287

Benest and **Duvent** say the star's mass is a maximum of 0.05Mo, rather less than the Dogon figure of 0.2585Mo. (Taking Sirius B = 1.034Mo)

Nevertheless, the mass of Sirius C is probably low, otherwise the perturbations would destroy the binary very rapidly; we may roughly estimate the maximum value for M_C to be around 0.05 $M_\odot$ (Sirius C would then be at best a red dwarf M5 with $m_v \geq 12$), which is much less than the masses of Sirius A and B, resp. 2.14 and 1.05 $M_\odot$

and later on they add,

In this study we have supposed that the 6-year perturbation in the orbit of Sirius A–B is due to the presence of a third body in the system, i.e. Sirius C. Dynamical and astrophysical considerations lead to a very low mass for this suspected companion: a maximum of 0.05 $M_\odot$, i.e. a M5 to M9 star of absolute magnitude 15 to 20. The visual magnitude of Sirius C could then be 5 to 10 more than that of the white dwarf Sirius B ($m_v = 8.5$), itself 10 more than that of Sirius A ($m_v = -1.5$), therefore very difficult to observe.

As for size, if Sirius C/Sirius B = Jupiter/Earth, then the ratio of radius size is about 11. So **Sirius C** is bigger than Sirius B.

Test 13
Sirius C has orbit of 50 (or 32*Renard Pale) years

Benest and **Duvent**'s figure for the orbit (which is ipso facto the proof of the star's existence) is mathematically rigorous: 6.3 years. Rather less than either 50 years and even the revised figure of 32 years.

$$F(t) = \sum_{k=1}^{q} A_k \cos(k\Omega t) + \sum_{k=1}^{q} B_k \sin(k\Omega t)$$

Fourier function as used by Benest and *Duvent*.

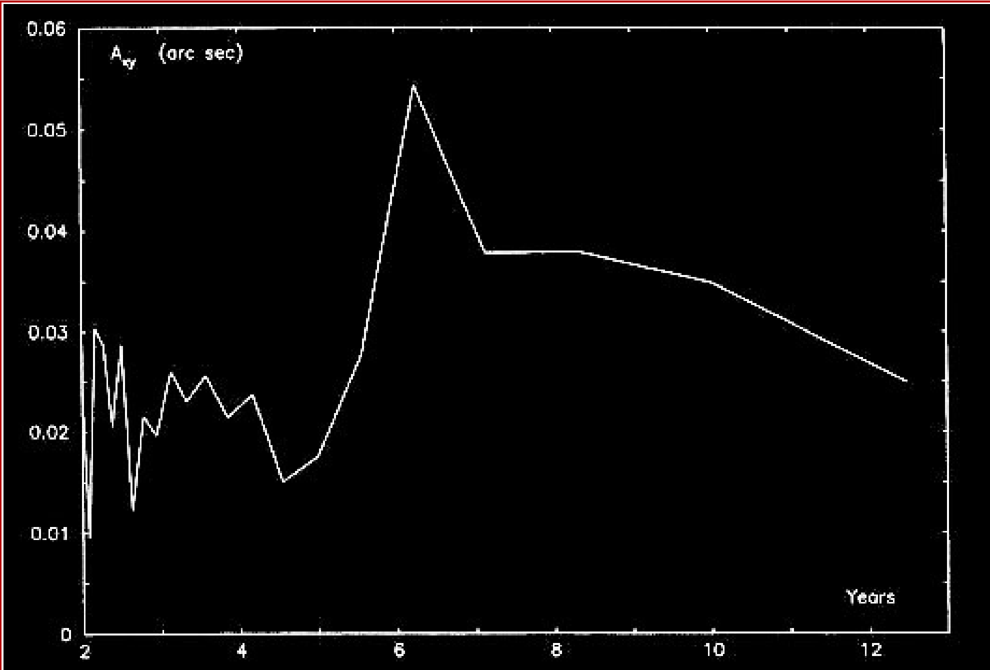


Fig. 3. Amplitude of A_{xy} in the mean square Fourier estimation, showing the peak at about 6.25 years

Although, with the reddening of Sirius still in mind, Bonnet-Bidaud and Gry's quote below spells out the conditions for the reddening.

> For interaction to occur, two conditions are required on the orbital elements of the third companion: a period P_3 longer than $\approx$ 2000 yr (the last interaction) and an approach distance (d) to the inner A–B binary of the same order than the average Sirius A–B separation i.e. 20 AU.

Tests 14-15

Sirius C has a "larger" orbit than Sirius B
Sirius C orbit is at right angles to that of Sirius B

[HOW CAN WE KNOW??????]

USSS saying Sirius **C** has a "larger" orbit than Sirius **B** has been interpreted as meaning more an orbit more circular than elliptical. In this discussion Benest and Duvent cite astronomers **J.R.Donnison** and **I. P. Williams**, who had calculated the hypothetical possibility of a stable three-body arrangement in the specific Sirius system in 1978.

> Do stable orbits exist around Sirius A and/or Sirius B with a period of 6 years? do stable orbits exist far around Sirius A–B which could perturb (for example through a resonance) the orbits of Sirius A and B around each other, again with a period of 6 years? The latter has been explored by, e.g., Donnison & Williams (1978)

Early into my quest, Donnison and Williams had been quoted in the popular paranormal literature by **Karl Shuker** as supports for the Dogon contentions and I emailed them about this. Dr. **Iwan P. Williams** was gracious enough to send me this email in response.

Thanks for taking the time out to talk to a rank amateur Dr. Williams!

> "At the time (as indeed now) there was a lot of interest in Planets around other stars and the paper mentioned really has to be seen within that context. we had written a number of papers enquiring about the stability of hypothetical systems and a relevant question was whether "planets" could exist within a binary star context. The *Dogon thing* came out about that time and it seemed appropriate to ask the same question about Sirius as for a general system, i.e. could we have a planet in particular given binary system i.e. Sirius.
>
> The Answer is not that remarkable, yes provided it is far enough away from the binary pair that the changes in gravity is small and it can be closer on average on a circular orbit (Mean distance = minimum distance)"

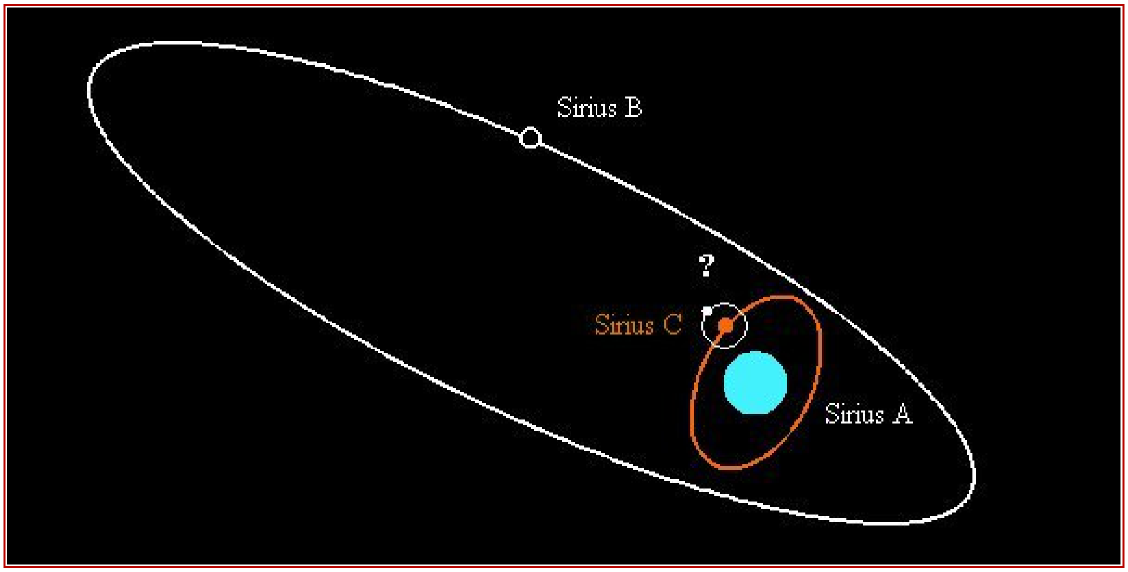
Tests 16-18

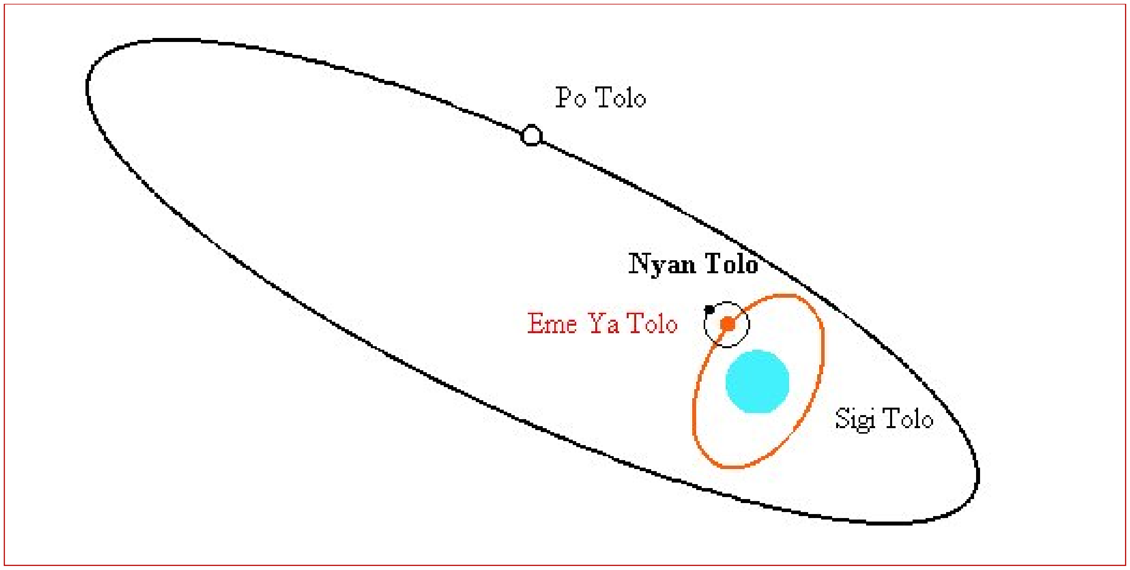
Sirius C has one main planet in orbit
Orbit of main planet is 30 years **(*Renard Pale)**
Sirius C has two planets in orbit **(*Renard Pale)**

Meanwhile, if Sirius **C** really has a planet, an orbit of 30 years is surely an over-estimate.

Does true imagination = real facts?

Diagram of Astronomical knowledge





Is Sirius a Triple Star?

from TheSAO/NASAAstrophysicsDataSystem Website

- Is Sirius a Triple Star? - by **D. Benest** and **J.L. Duvent** - 1994

Return to Sirius